

## *MYXINE SOTOI*, A NEW SPECIES OF HAGFISH (AGNATHA, MYXINIDAE) FROM BRAZIL

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### ABSTRACT

A new species of hagfish, *Myxine sotoi* (Agnatha, Myxinidae), is described based on 30 specimens collected off southeastern and southern Brazil, at depths between 690 and 810 m. It is a six-gilled species, body color pinkish red with white head, a whitish mid-dorsal stripe extending from the caudal finfold to about over gill apertures, and a 2-cusp multicusp on both the anterior and posterior sets of cusps.

Hagfishes are primitive agnathous, cartilaginous, eel-like, entirely marine, bottom-dwelling scavengers, feeding on dead or moribund fish and invertebrates. Habitat is usually soft mud at depths ranging from a few to at least 2700 m. In colder waters some species live in shallow depths and among rocks.

The genus *Myxine* is mainly characterized by having all efferent gill pouch ducts discharging into a single aperture on each side, the left usually being confluent with the pharyngocutaneous duct (Wisner and McMillan, 1995).

A preliminary review of New World hagfishes of the genus *Myxine* was presented by Wisner and McMillan (1995), who recorded 14 species from the Pacific and Atlantic coasts of the American continent.

During a deep-water trapping survey off southeast and south coast of Brazil, 30 specimens of an undescribed species of *Myxine* were collected by the REVIZEE Program (Program for Assessment of the Sustainable Yield of Living Resources of the Exclusive Economic Zone). In this paper, this new species is described and compared to *M. mcmillanae* Hensley, 1991, a very similar species from the Caribbean Sea.

### MATERIALS AND METHODS

Measurements and counts essentially follow Fernholm and Hubbs (1981) and McMillan and Wisner (1984). The data obtained were compared with similar data of *M. mcmillanae*, presented by Hensley (1991) and Wisner and McMillan (1995). Anatomical terminology is according to Wisner and McMillan (1995). The specimens were collected using baited traps on the continental slope of southeastern and southern Brazil, and are deposited in the following repositories: MCP – Museu de Ciências e Tecnologia da Pontifícia Universidade Católica do Rio Grande do Sul (Porto Alegre, Brazil), MOVI – Museu Oceanográfico do Vale do Itajaí (Itajaí, Brazil); MZUSP – Museu de Zoologia da Universidade de São Paulo (São Paulo, Brazil); and USNM – National Museum of Natural History (Washington, DC, USA).

*Myxine sotoi* new species  
(Fig. 1)

*Holotype*.—MOVI 14961, mature female, 506 mm TL, sta. 6636: 27°28'08"S, 46°53'02"W, 810 m depth, 9 December 1997, RV PROF. W. BESNARD.

*Paratypes*.—MOVI 14950–14960, 11 spec. (410–511 mm) and MZUSP 62880, 6 (399–485 mm), taken with holotype. MCP 26199, 2 (395–428 mm), MOVI 14936–14941, 6 (393–522 mm), MZUSP 62879, 3 (398–495 mm), and USNM 364209, 1 (356 mm), sta. 6623: 24°13'52"S, 43°11'08"W, 690 m depth, 6 December 1997, RV PROF. W. BESNARD.

*Diagnosis*.—A species of *Myxine* with six pairs of gill pouches; a 2-cusp multicusp on both the anterior and posterior sets of cusps, total cusps 38–44; prebranchial pores 28–38, trunk pores 61–73, tail pores 11–13, total pores 101–119; ventral finfold 4–6 mm high; color of live specimens pinkish red with whitish head anterior to first slime pore; whitish middorsal stripe extending from caudal finfold to about over gill apertures.



Figure 1. *Myxine sotoi*, holotype, 506 mm TL.

Table 1. Measurements from *Myxine sotoi* and *M. mcmillanae*\*.

	<i>Myxine sotoi</i>			<i>Myxine mcmillanae</i>		
	30 specimens inc. holotype		Holotype	43 specimens inc. holotype		Holotype
	mean ± SD	range		mean ± SD	range	
Total length TL (mm)	448.0 ± 44.0	356.0–522.0	506	380.0 ± 51.5	271.0– 473	393
Measurements in % of TL						
Prebranchial length	29.8 ± 0.9	28.4–31.2	29.6	28.6 ± 1.1	26.3–30.9	29.3
Trunk length	58.9 ± 1.0	56.8–61.3	59.3	58.6 ± 1.2	56.5–60.9	56.5
Tail length	11.3 ± 0.8	8.9–12.8	11.1	12.5 ± 0.7	10.8–13.8	13.2
Body width	4.7 ± 0.4	3.9–5.7	4.2	4.4 ± 0.5	3.6–5.7	4.0
Body depths:						
Inc. ventral finfold	6.2 ± 0.5	5.0–7.5	6.5	6.0 ± 0.8	4.3–7.9	5.7
Exc. ventral finfold	5.6 ± 0.6	4.2–7.0	6.1	5.3 ± 0.7	4.0–7.2	4.9
Over cloaca	5.6 ± 0.4	5.0–6.8	5.7	5.1 ± 0.5	4.2–6.1	4.5
Tail depth	5.5 ± 0.3	4.9–6.5	5.5	5.3 ± 0.5	4.4–6.1	5.1
Barbels:						
First	0.8 ± 0.1	0.7–1.1	0.8	0.8 ± 0.1	0.6–1.1	0.9
Second	0.9 ± 0.1	0.8–1.1	0.8	0.9 ± 0.1	0.6–1.2	0.9
Third	1.3 ± 0.1	1.1–1.5	1.2	1.3 ± 0.1	1.0–1.5	1.3

\* From Hensley (1991).

Table 2. Number of cusps from *Myxine sotoi* and *M. mcmillanae*\*. Values for holotypes are underlined.

	Anterior unicusps													
	7	8	9	10									n	mean
<i>M. sotoi</i>	2	24	<u>22</u>										48	8.42
<i>M. mcmillanae</i>		5	<u>28</u>	8									38	9.00
	Posterior unicusps													
	8	9	10										n	mean
<i>M. sotoi</i>	29	<u>19</u>											48	8.40
<i>M. mcmillanae</i>	3	<u>25</u>	10										38	9.18
	Total cusps													
	38	39	40	41	42	43	44	45	46	47	48		n	mean
<i>M. sotoi</i>	1		7	2	<u>7</u>	3	4						30	41.63
<i>M. mcmillanae</i>					3	2	6	5		2	1		19	44.37

\* Cusp data for the holotype (USNM 308405) are from Hensley (1991), also from 10 specimens (SIO 90-21) examined by Robert L. Wisner, and 8 specimens (USNM 308406) examined by the author (M.M.M.). The data of cusps counts from Wisner and McMillan (1995, p. 546, table 6) have been corrected for errors in frequency distribution data which were not discovered until after publication (Charmion B. McMillan, pers. com.).

**Description.**—Measurements and counts are presented in Tables 1, 2 and 3. Body slender, slightly deeper than wide; tail narrow, its length 8.9–12.8% of TL, its depth 41.4–59.1% of its length. Rostrum triangular with slightly rounded tip. Six gill pouches on each side. Ventral finfold originating within anterior 12% of trunk, extending to cloaca, progressively reducing from 4–6 mm (origin) to 1 mm high (cloaca). Caudal finfold thick ventrally and thin dorsally, originating at posterior margin of cloaca, continuing around tail, terminating within posterior 20% of trunk. Dental muscle reaching second gill pouch. Anteriormost branch of ventral aorta at end of dental muscle.

Body color of live specimens pinkish red; preserved specimens (ethanol) grayish purple. Head anterior to first slime pore white; some specimens with whitish band ventrally limited between lines of prebranchial pores; ventral finfold with distal margin whitish and proximal margin variably reddish or whitish; prebranchial pores, gill apertures, trunk pores, cloaca, and caudal finfold with whitish margins, tail pores without whitish margins; whitish middorsal stripe extending from caudal finfold to over gill apertures in all examined specimens; occasional whitish spots on lateral and dorsal surface of trunk.

**Distribution.**—Western Atlantic Ocean, southeastern and southern Brazil, at depths between 690 and 810 m.

**Reproduction.**—Of the 30 specimens examined, 26 were females, three males and one hermaphrodite. Only four females have large eggs measuring approximately  $20 \times 6$  mm, but none of the eggs examined showed encapsulated anchor filaments.

**Etymology.**—I am pleased to dedicate this species to Jules Marcelo Rosa Soto, in recognition of his extensive work on the Brazilian marine fauna and for encouraging me in the study of the myxinids.

**Comparisons.**—I have compared *Myxine sotoi* with *M. mcmillanae*, a very similar species from Puerto Rico and the U.S. Virgin Islands, and found no significant differences in body proportions between the two species. There is overlapping in all the slime pore and cusp counts, however some differences were observed in the ranges, mainly in anterior and posterior unicusps, total cusps, and tail pores (Tables 2,3). Likewise, although there is

Table 3. Number of slime pores from *Myxine sotoi* and *M. mcmillanae*\*. Values for holotypes are underlined.

		Prebranchial slime pores																			n		mean					
		26	27	28	29	30	31	32	33	34	35	36	37	38														
<i>M. sotoi</i>				1		4	5	6	7	3		2	1	1							30	32.50						
<i>M. mcmillanae</i>	1	3	5	7	10	8	6	1	2												43	31.00						
Trunk slime pores																												
	60	61	62	63	64	65	66	67	68	69	70	71	72	73							n		mean					
<i>M. sotoi</i>		2	1	1	4	5	1	5	1	6	2		1	1							30	66.53						
<i>M. mcmillanae</i>	1	5	4	5	5	7	5	6	2	1	2										43	64.65						
Tail slime pores																												
	9	10	11	12	13															n		mean						
<i>M. sotoi</i>			15	13	2															30	11.57							
<i>M. mcmillanae</i>	3	22	15	3															43	10.50								
Total slime pores																												
	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	n		mean						
<i>M. sotoi</i>	1			1	1		2	3	4	1	6	2	5		1		1	1	1	30	110.60							
<i>M. mcmillanae</i>	3	5	1	3	8	3	1	5		8	2	2	2	2	12					43	106.83							

\* From Wisner and McMillan (1995).

an overlap in ranges of total length, the means differ by 68 mm which may indicate a difference in size. Both species have the head white anterior to the first slime pore, but they are different in body color of living specimens, bluish gray in *M. mcmillanae* and pinkish red in *M. sotoi*. Both in Hensley's description and in the specimens examined, *M. mcmillanae* occasionally has a whitish middorsal stripe of variable length. However, in *M. sotoi*, the whitish middorsal stripe extends from the caudal finfold to about over gill apertures in all specimens.

According to Hensley (1991), three other *Myxine* species with white heads have been described: *M. circifrons* Garman, 1899, from the eastern Pacific; *M. garmani* Jordan and Snyder, 1901, from Japan, and the Irish population of *M. ios* Fernholm, 1981. *Myxine sotoi* may be distinguished from these other species mainly by its highly unusual body color, as well as by the number of gill pouches (five in *M. circifrons* and predominately seven in *M. ios* vs six in *M. sotoi*), and multicusps pattern (3/2 in both *M. circifrons* and *M. garmani* vs 2/2 in *M. sotoi*).

*Comparative material.*—*Myxine mcmillanae*: USNM 308406, 10 spec. (282–459 mm TL), 18°26'54"N, 67°19'30"W, approx. 1500 m depth, minnow trap, 12–13 February 1986. SIO 90-21, 10 spec. (343–473 mm TL), 18°00.15'N, 67°56.75'W, 1100 m depth, shrimp trap, 8–9 March 1984.

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